

Plastic Membrane Device (PMD) samplers Placement and Retrieval Methods

Introduction

The purpose of this manual is to describe in detail methods used to deploy and retrieve plastic membrane device (PMD) samplers. These PMDs may be placed in water or air to detect hydrocarbons. We have employed PMDs to sample lake and stream water, and intertidal sediment (which cycled between wet and dry phases due to tidal flux).

Two different devices are discussed. The first version held PMDs with either one or no folds, and were relatively long cylinders (11.4 cm diameter by 69 cm long) (Figures 1-7). These required loading and unloading in the field. In version II devices, PMDs are extensively folded, thus the size of the devices was much smaller (11.4 cm diameter by 6 cm long) (Figure 8). Because they are smaller, version II samplers are easier to clean chemically (with methylene chloride), can be pre-loaded with an LDPE strip in the laboratory, and require less volume for transportation, storage, and installation.

Summary of methods

Version I devices

Plastic membrane devices (PMDs) were placed in each stream to detect dissolved hydrocarbons. Two types were used, semi-permeable membrane devices (SPMDs) and low density polyethylene (LDPE) strips. The SPMDs are commercially produced samplers that consist of a 1 m × 2.6 cm hollow LDPE strip that encloses a triolein reservoir. The LDPE strip samplers had the same surface area as the SPMDs, 0.5 m × 5.2 cm, but contained no reservoir and were flat, not hollow.

The SPMDs arrived from the supplier ready for installation, but the LDPE strips (88 μm thick) required solvent cleaning before deployment. Batches of 15 strips were placed in pentane and alternately sonicated 15 min and soaked for 30 min (2 cycles). After a final 15 min sonic extraction, each strip was rinsed with pentane as it was removed from the solvent, placed in a hydrocarbon-free glass jar, covered with a methylene chloride-rinsed aluminum-foil lid, and stored at 0°C until deployment.

The PMDs were transported in metal or glass containers, and deployed on site in 0.69 m long × 8.9 cm diameter tubes formed from 1 mm aluminum plate perforated with 3 mm holes spaced 4.8 mm on center. A 7.6 cm long × 8.9 cm diameter section of aluminum pipe at each end provided structural support. The PMDs were suspended centrally in each tube from stainless steel clips fastened to nylon line. Tube ends were capped with window screen. Tubes, screens, and all associated hardware were washed with soap and water, dried, and rinsed with methylene chloride prior to use.

Version II devices

A second generation sampler configuration was developed for LDPE installation to address deficiencies in the original design. Because they are smaller, these samplers are easier to clean chemically (with methylene chloride), can be pre-loaded with an LDPE strip in the laboratory, and require less volume for transportation, storage, and installation.

The LDPE strip samplers had the same surface area as in the original samplers, 0.5 m × 5.2 cm, but a 3 cm loop was formed on each end by heat sealing (sealed area was ~2 mm wide). LDPE strips were solvent cleaned as before and placed in aluminum cannisters (10.2 cm internal diameter with 0.6 cm walls × 6 cm pipe and 2 mm thick aluminum end plates perforated with 3 mm holes spaced 4.8 mm on center). Cannisters and tools were washed with soap and water, dried, and rinsed with methylene chloride before use. The LDPE was wound through 9 six-mm aluminum posts using solvent-rinsed forceps. Each cannister was wrapped in solvent-rinsed aluminum foil and sealed in two plastic ziplock bags. Samplers were frozen until transportation. A solvent-cleaned hose clamp secured nylon rope to the housing to anchor the devices in place.

Detailed Methods

Remember – all equipment and samplers must be suitably cleaned beforehand.

LDPE cleanup

Material:

Virgin (no additives) low density polyethylene
Brentwood Plastics Inc.
8764 Manchester Road
Suite 200
Brentwood, MO 63144 (314) 968-1135

LDPE strips 88 μ m thick × 0.5 m long × 5.2 cm wide were cleaned with solvent before deployment. Batches of 15 strips were placed in pentane and alternately sonicated 15 min and soaked for 30 min (2 cycles). After a final 15 min sonic extraction, each strip was rinsed with pentane as it was removed from the sonic bath and stored in a certified I-Chem jar with a methylene chloride rinsed aluminum foil lid and stored at 0°C until deployment..

Version I devices

Version I devices are rigged in the field just before placement. However, we are discussing methods to pre-rig PMDs in the lab. At issue is the ability of PMDs to sample air, and this must be avoided.

Transport PMDs to the field in light-tight or low-light containers. For example, the glass bottle wrapped in duct tape was used to transport LDPEs to the field (5-10 per bottle). Treat at least 1 LDPE per bottle as a blank.

LDPE rigging (Figure 1).

Suspend an “S”-hook with nylon cord from a suitable object to use as a holding point. Remove a strip from the transport jar with locking forceps. Lock one pair of forceps on an end, and hang the forceps from the hook. Grab the other end with a second pair of forceps (this can be tricky in the wind – you might need to follow the plastic down with your forceps from the hook to the bottom).

Holding the lower end of the plastic, pierce a mounting clip through it (holes – see also Fig. 3). Cut about 2 feet of nylon cord, double it, and make a simple slip-knot at the apex of the clip.

Holding the lower mounting cord, grab upper forceps and invert the strip (place the clip in the hook and the cord out of the way over the suspending object). Mount the second clip and cord.

SPMD rigging

Use the same techniques, but use different clips. Fold SPMDs in half within the sampler tube with the fold upstream. Rigging is easiest if 2 clips are used on the two (downstream) ends.

The nylon cord was assumed clean at purchase, and did not cause problems in our study. Keep it clean, however: use a hydrocarbon-free can or jar as a spool holder. (SPMDs come in metal ‘paint’ cans from the manufacturer. If you reseal these cans after removing the SPMD they can later be used for device collection.)



Figure 1. Field rigging Version I devices.

LDPE and SPMD mounting clips.

LDPE clips are made from 1/16" stainless steel welding rod (Figure 2). Be sure to pierce plastic far enough from the end of the strip that the holes will not rip out. I find it easiest to hold the plastic firmly with forceps and pierce the plastic immediately above the edge of the forceps. After placing the clip, crimp the open ends inward with stainless steel pliers.

SPMD clips have a 'keeper' to prevent the clip from opening accidentally (Figure 2). Slip the plastic over the end of the clip, then use forceps and or pliers to place the keeper over the support rod. These clips are also made of 1/16" stainless steel welding rod.

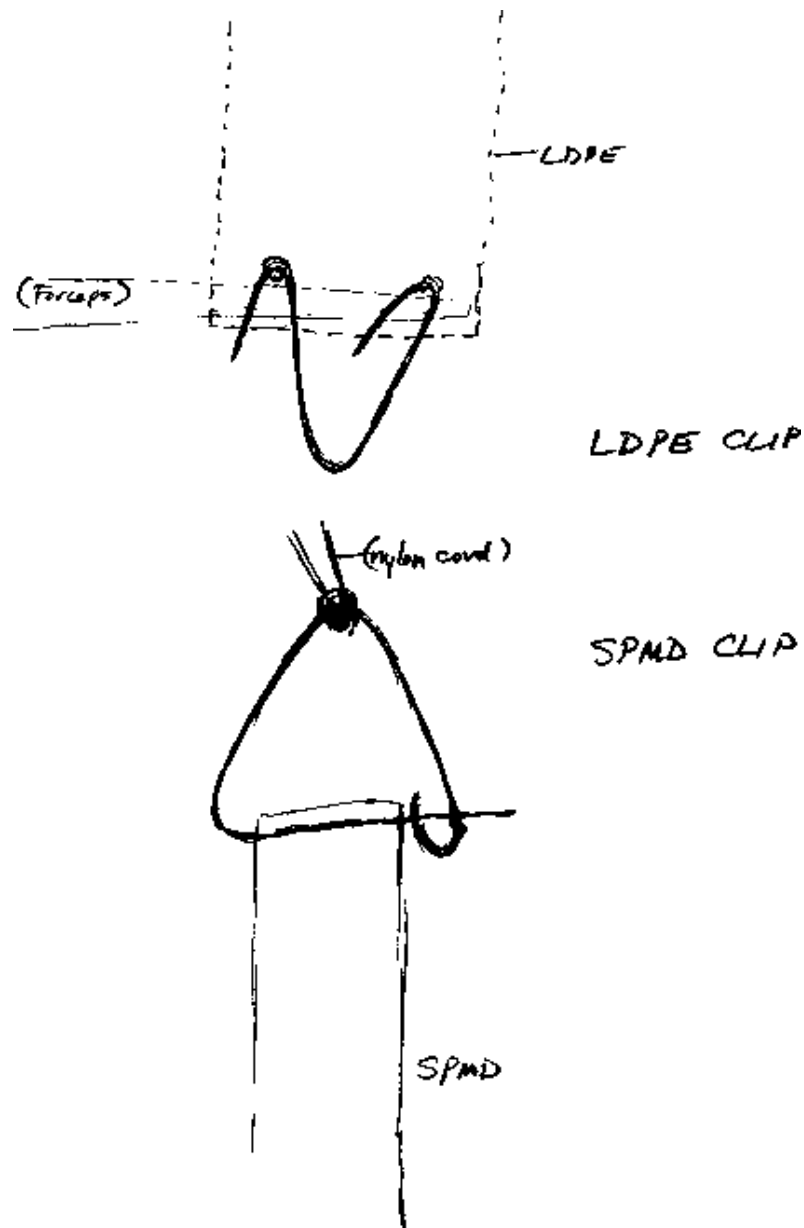


Fig 2. LDPE and SPMD mounting clips.

Sampler tube size, hardware, and PMD mounting.

Rig PMD with attachment hardware (see Fig 2) and drop into the housing Figure 3). Remember to put a single twist in the plastic on one side to ensure that all surfaces will be exposed to the surrounding fluid.

Cap one or both ends with aluminum window screen. (I recommend capping only the upstream end in situations where flow is unidirectional to avoid sediment accumulation.) Hold screens in place with hose clamps (place clamp below the shackle hole on the upstream end). The hose clamps also hold the light-weight nylon cord connected to the stainless steel mounting hooks. To connect the shackle, poke suitably sized holes in the window screen.

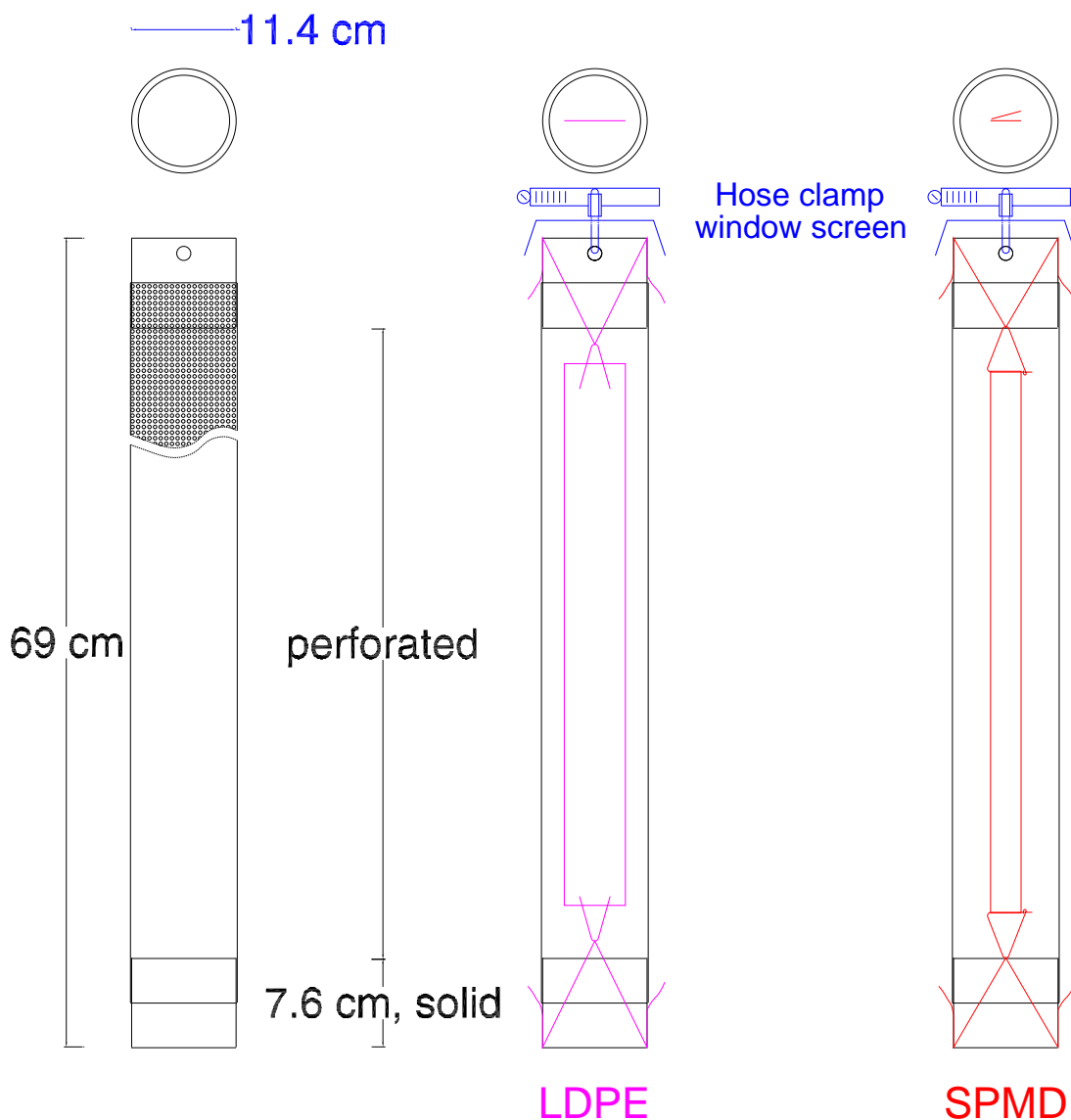


Fig 3. Sampler tube size, hardware, and PMD mounting.

Fig 4. Example LDPE suspended in sampler tube (end screens were omitted for this photograph).



Fig 5. Completely rigged sampler being placed in a stream. Before placement, holes were dug in the stream bed and duckbill anchors were hammered in slightly upstream of the holes. We used chain to connect the anchor cable to each sampler.



Fig 6. Replicate samplers in place. This arrangement was employed in the fall of 1999 in 6 PWS streams. Five samplers were placed at each of 4 tidal elevations in each stream. Four of these samplers contained LDPEs and one contained an SPMD. A single anchor was used for each group of 2 or 3 samplers. After placement, samplers were covered with stream gravel so they would sample water as in natural salmon redds.



Fig 7. To collect PMDs, retrieve the samplers, making sure not to contaminate them in the process. Remove the tube end(s), and pull the plastic free. Clip onto one end with forceps, and remove the support clip. Repeat to remove the second clip. Wind the plastic around one forceps – the other will provide weight for a tight wind. Especially in rainy conditions, where there is potential for drips to enter samples and possibly contaminate them, hold the sample jar (or can) sideways. (A helper is convenient at this point.) Unclip the outer forceps and unwind the central forceps enough to release the plastic. Cover the jar with pre-cleaned aluminum foil, then thread the teflon-lined cap on. Freeze the samples until processing.



LDPE / SPMD installation equipment for 8 devices:

2	shovels	cleaned	
1	sledge hammer (8 lb)	cleaned	
1	pounding rod (3/4" dia)	cleaned	
6	duckbill anchors (size 88)	cleaned	
~50'	chain (assumes 6' x 8 devices)	cleaned	
*	Alternatively, use nylon rope for anchoring.		
1	chain cutter	cleaned	
4	shackles, large – for anchors & chain	cleaned	
8	Aluminum housings	cleaned	
16	hose clamps, stainless steel	cleaned	
16	stainless steel wire strip mounts	cleaned	
16	window screen, 7" squares, Al	cleaned	consider only capping upper ends!
6	shackles, small — for housings	cleaned	
1	hex driver (5/16 “) for hose clamps	cleaned	
1	screwdriver	cleaned	
2	wrenches for shackles (7/16")	cleaned	
10	LDPE strips in 2 jars	cleaned	(2 serve as field blanks)
3	S-hooks for strip mounting	cleaned	(a minimum of 1 is required)
1 pkg	disposable gloves		
3	scissors	cleaned	wrapped in aluminum
3-6	forceps, locking	cleaned	wrapped in aluminum
1-3	stainless steel pliers	cleaned	wrapped in aluminum
1	roll nylon cord		
1	empty can to serve as cord holder	cleaned	
2 rolls	paper towels		
1 box	Ziplock bags, 1 gallon	(transport all cleaned gear in zip lock bags)	
1 box	garbage bags	(wrap cleaned housings in these for transport)	
	pre-cleaned aluminum sheets	transport in ziplock bag(s) – size for tray	
1	shallow tray to use as tool holder	(use a plastic rubbermaid container. line with foil)	
*	methylene chloride	squeeze bottle + extra (solid) cap & appropriate pkg <i>optional, & dependent on shipping restrictions. If you don't have methylene chloride, then a good selection of pre-cleaned tools are advisable (as above).</i>	
6	jars (or cans) for membrane retrieval clean		
6	aluminum foil sheets for jar sub-cap clean		
1	Chain of custody sheet		

- 2 tape measures, 100 m
- 10 eye hooks
- 1 roll survey tape

Use tape measures to triangulate from fixed landmarks that can be found on the return trip. I tend to use small trees. Eye hooks can be screwed in place as anchor points for measurement. Flag trees with survey tape if desired. You might need to think about security issues...

GPS

compass

map

camera & film

notebook, pens, pencils

VHF radio

metal detector

for return trip only!

Personal gear:

Waders, rain gear, float coat

variety of gloves

LDPE / SPMD Retrieval

1	shovel	cleaned	
1	box garbage bags - to collect housings, etc.		
1	hex driver (5/16 ") for hose clamps	cleaned	
1	screwdriver	cleaned	
2	wrenches for shackles (7/16")	cleaned	
2	BLANKS! LDPE strips in 2 jars	open each jar briefly in the field.	
3	S-hooks for strip mounting	cleaned	(a minimum of 1 is required)
	<i>Probably not needed, but potentially useful.</i>		
1 pkg	disposable gloves		
3	scissors	cleaned	wrapped in aluminum
3-6	forceps, locking	cleaned	wrapped in aluminum
1-3	stainless steel pliers	cleaned	wrapped in aluminum
1	roll nylon cord		
1	empty can or jar to serve as cord holder	cleaned	
2 rolls	paper towels		
1 box	Ziplock bags, 1 gallon	(transport all cleaned gear in zip lock bags)	
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6	jars (or cans) for membrane retrieval	clean	
6	aluminum foil sheets for jar sub-cap	clean	
1	Chain of custody sheet		
2	tape measures, 100 m		
	GPS		
	compass		
	map		
	camera & film		
	notebook, pens, pencils		
	VHF radio		
	metal detector	for return trip only!	

Version II LDPE Samplers

A second generation sampler configuration was developed for LDPE installation to address deficiencies in the original design. The new samplers are easier to clean chemically (with methylene chloride), can be pre-loaded with an LDPE strip in the laboratory, and require less volume for transportation, storage, and installation.

The LDPE strip samplers had the same surface area as in the original samplers, $0.5 \text{ m} \times 5.2 \text{ cm}$, but a 3 cm loop was formed on each end by heat sealing (sealed area was $\sim 2 \text{ mm}$ wide <check>). LDPE strips were solvent cleaned before deployment as before and placed in aluminum cannisters (10.2 cm internal diameter with 0.6 cm walls \times 6 cm pipe and 2 mm thick aluminum end plates perforated with 3 mm holes spaced 4.8 mm on center). Cannisters and tools were washed with soap and water, dried, and rinsed with methylene chloride before use. The LDPE was wound through 9 six-mm aluminum posts (Figure 1). Each cannister was wrapped in methylene chloride-rinsed aluminum foil and sealed in two plastic ziplock bags. Samplers were frozen until transportation. A solvent-cleaned hose clamp secured nylon rope to the housing for field deployment.



Figure 8. Version II sampler.